UKNC Conference Programme

Swansea University

7th-8th January 2026

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Prof David Binks: david.binks@manchester.ac.uk
Dr Matt Smith: matt.smith@bristol.ac.uk
Prof Rachel Oliver: rao28@cam.ac.uk

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Wednesday 7th of January 2026.

09:30-10:10 Arrival, Registration and Coffee (sponsored by Taiyo Nippon Sanso)
Computational Foundry, Ground Floor Foyer and Networking Space (Room 001)

10:10-10:15 Welcome and Opening Remarks
Computational Foundry, Lecture Theatre 002

10:15-11.00 Invited Talk - Chair: Prof. Rachel Oliver
Computational Foundry, Lecture Theatre 002

Exploring electrochemical etching as a tool for cladding engineering in III-nitride laser diodes
Marta Sawicka
Institute of High Pressure Physics Polish Academy of Sciences (IHPP PAS), Warsaw, Poland

11.00-12.00 Session 1: Optoelectronics - Chair: Prof. Rachel Oliver
Computational Foundry, Lecture Theatre 002

11.00-11.15 **Linearly Polarised Emission from C-Plane InGaN Quantum Dots Grown by MOVPE**
C. Zhao[1], Z. S. Pehlivan[1], G. Kusch[1], M. J. Kappers[1], R. A. Oliver[1]
[1]University Of Cambridge, Cambridge, United Kingdom

11.15-11.30 **Porosity and relaxation in Al-rich AlGaN**
E. Jaaskelainen[1], T. R. Harris-Lee[1], M. Grigoletto[2], A. Chatterjee[1], M. Frentrup[1], M. J. Kappers[1], T. Wernicke[2], M. Kneissl[2], R. A. Oliver[1], G. Kusch[1]
[1] Department of Materials Science and Metallurgy, University of Cambridge, United Kingdom, [2]Institute of Solid State Physics, Technische Universität Berlin, Germany

11.30-11.45 **Pathways to Efficient Red Micro-LEDs: Analysis of 100-mm InGaN-on-Silicon Wafer**
K. Nicholson[1], R. Alshammary[1], N. Zarrabi[2], S. Wood[2], T. Wang [1], N. Gunasekar[1]
[1]School of Physics and Astronomy, Cardiff University, The Parade, Cardiff, UK, CF24 3AA
[2]National Physical Laboratory (NPL), Teddington, Middlesex, UK

11.45-12.00 **Development of GaN Micro-Pyramids and Platelets with High Uniformity for micro-LED applications**
C. Li[1], V. Zubialevich[1], P. Parbrook[1], B. Corbett[1], Z. Li[1]
[1] Tyndall National Institute, , Ireland

12.00-13.00 Lunch
Computational Foundry, Ground Floor Foyer

13.00-13.45 The Humphreys Lecture - Chair: Dr. Matt Smith
Computational Foundry, Lecture Theatre 002

Current Transport in AlN Schottky Barrier Diode
Takuya Maeda
University of Tokyo, Japan

13.45-14.45 Session 2: Electrical Devices - Chair: Dr. Matt Smith
Computational Foundry, Lecture Theatre 002

13.45-14.00 **Investigation of Leakage Current Paths in GaN-Based Nanoribbon Devices**
B. Ubochi[1], K. Ahmeda[2], B. Benbakhti[3], **K. Kalna[4]**
[1]Department of Electrical and Electronics Engineering, School of Electrical Systems Engineering, The Federal University of Technology, Nigeria, [2]Dynex Semiconductor, Ltd., United Kingdom, [3]Liverpool John Moores University, [4]Swansea University, United Kingdom

14.00-14.15 **Resistance Contributions to Quasi-Vertical GaN-on-SiC MOSFETs at Elevated Temperature**
J. Evans[1], F. Monaghan[1], R. Harper[2], A. B. Khaial[1], M. Elwin[1], M. Jennings[1]
[1]Centre for Integrative Semiconductor Materials and Department of Physics, Swansea University, Bay Campus, Fabian Way, Swansea SA1 8EN, United Kingdom, [2]Compound Semiconductor Centre Ltd, St. Mellons, Cardiff, United Kingdom

14.15-14.30 **Investigation of Forward Current Behaviour in a Thin Barrier AlGaN/GaN Schottky Diode at Cryogenic Temperatures**
N. Suphannarat[1], S. Ghosh[1], A. Chatterjee[1], F. Adams[1], M. Kappers[1], D. Wallis[1], R. Oliver[1]
[1]Department of Materials Science & Metallurgy, University of Cambridge, United Kingdom

14.30-14.45 **Terahertz detection via the in-plane photoelectric effect in 2D electron systems: from AlGaAs/GaAs HEMTs to AlGaN/GaN HEMTs**
R. Chen[1], M. Tan[1], S. Ghosh[2], M. J. Kappers[3], H. E. Beere[1], R. A. Oliver[3], D. A. Ritchie[1], [2], **W. Michailow[1]**
[1]Cavendish Laboratory, University of Cambridge, Cambridge CB3 0HE, United Kingdom, [2]Centre for Integrative Semiconductor Materials and Department of Physics, Swansea University, Bay Campus, Fabian Way, Swansea SA1 8EN, United Kingdom, [3]Department of Materials Science and Metallurgy, University of Cambridge, Cambridge CB3 0FS, , United Kingdom

14.45-15.15 Coffee (sponsored by IQE)
Networking space (001)

15.15-16.15 Session 3: Emerging Materials, Defects and Characterization - Chair: Dr. Fabien Massabuau
Computational Foundry, Lecture Theatre 002

15.15 -15.30 **Controlled growth of defects in gallium nitride that emit quantum light at room temperature**
K. Eggleton[1], J. Cannon[1], S. Bishop[1], J. Hadden[1], C. Zhou[2], M. Kappers[2], R. Oliver[2], A. Bennett[1]
[1]Cardiff University, Cardiff, United Kingdom, [2]University of Cambridge, United Kingdom

15.30 -15.45 **On the origin of deep-level defects E1 and E3 in GaN and dilute AlGaN alloys**
P. Kruszewski[1], V. Markevich[2], **C. Dawe[2]**, J. Coutinho[3], L. Sun[2], P. Prystawko[1], J. Plesiewicz[1], M. Halsall[2], D. Binks[2], A. Peaker[2]
[1] Institute of High Pressure Physics and Polish Academy of Sciences, Poland, [2]Photon Science Institute, The University of Manchester, United Kingdom, [3]i3N and Department of Physics, University of Aveiro, , Portugal

15.45 -16.00 **Fundamental properties of boron containing III-nitrides alloys: Combining an empirical atomistic valence force field model with density functional theory for future large scale simulations**
A. Power[1,2], C. Nies[1], S. Schulz[1,2]
[1]Tyndall National Institute, University College Cork, Ireland, [2]School of Physics, University College Cork, Ireland

16.00 -16.15 **Overview of AFM characterization methods for Nitride materials**
J. Qi[1], **M. Febvre[2]**, P. Dewolf[2]
[1]Bruker UK, United Kingdom, [2]Bruker France, France

16:15-17:30 Host introduction and facility tour

16.15 -16.30 **Introduction to** the **Centre for Integrated Semiconductor Materials (CISM) facility**
S. Ghosh[1]
[1]Centre for Integrative Semiconductor Materials (CISM) and faculty of science and Engineering, Swansea University, SA1 8EN Swansea, UK, United Kingdom

16.30 -17.30 **Facility tour**
CISM building

17.15-18.15 AGM
Computational Foundry, Lecture Theatre 002

19.00 Drinks Reception & Conference Dinner (sponsored by AIXTRON)
The National Waterfront Museum, Marina

Thursday 8th of January 2026

09.00-09.45 Foxon Lecture - Chair: Prof. Martin Kuball
Computational Foundry, Lecture Theatre 002

Vertical GaN power devices on native and non-native substrates
Matthew Smith
University of Bristol, Bristol, UK

09.45-10.45 Session 4: Gallium Oxide - Chair: Prof. Martin Kuball
Computational Foundry, Lecture Theatre 002

09.45 -10.00 **On the nature of electrically active deep-level defects in silicon doped MOCVD grown β-Ga2O3 epilayers**
*C. Dawe[1], **D. M. Lendering[1]**, V. Markevich[1], J. Jacobs[2], I. Hawkins[2], M. Halsall[2], A. Peaker[3], A. Nandi[1], M. Kuball[1] and Naresh Gunasekar[1]*
[1]Photon Science Institute and Department of Electrical and Electronic Engineering, University Of Manchester, Manchester, United Kingdom, [2]Centre for Device Thermography and Reliability (CDTR), HH Wills Physics Laboratory, University of Bristol, United Kingdom

10.00 -10.15 **Exploring Temperature induced effects when growing amorphous Ga_2O_3 using Close Coupled Showerhead MOCVD**
A. Moore[1], C. Llewelyn[2], D. Lamb[2], L. Li[1]
[1]Centre for Integrative Semiconductor Materials (CISM) and faculty of science and Engineering, Swansea University, SA1 8EN Swansea, UK, United Kingdom, [2]The Oxide and Chalcogenide Facility, Centre for Integrative Semiconductor Materials (CISM), Faculty of Science and Engineering, Bay Campus, Swansea University, SA1 8EN, UK, United Kingdom

10.15 -10.30 **Wafer-scale MBE of two-dimensional GaSe semiconductors and its post-growth conversion to Ga_2O_3**
S. Novikov[1], T. S. Cheng[1], J. Bradford[1], N. D. Cottam[1], M. Shiffa[1], K. Rahman[1], S. Alghamdi[1], B. T. Dewes[1], A. A. Alzeer[1], M. Mundszinger[2], J. Biskupek[2], U. Kaiser[2, 3], T. Klee[4], J. J. Broughton[4], C. J. Mellor[1], O. Makarovskiy[1], P. H. Beton[1], T. Ben[5], D. Gonzalez[5], J. W. G. Tisch[4], J. N. O'Shea[1], A. Patanè[1]
[1]University Of Nottingham, Nottingham, United Kingdom, [2]Ulm University, , Germany, [3]Institute for Quantum Optics, Ulm University, , Germany, [4]Imperial College London, , United Kingdom, [5]Universidad de Cadiz, Spain

10.30 -10.45 ***Electron microscopy investigation of laterally overgrown α-Ga_2O_3***
L. Penman[1], M. Maruzane[1], Y. Oshima[2], P. Edwards[1], R. Martin[1], F. Massabuau[1]
[1]University Of Strathclyde, Glasgow, United Kingdom, [2]National Institute for Materials Science, Japan

10.45-11.15 Coffee break (sponsored by Taiyo Nippon Sanso)
Networking space (001)

11:15-12:15 Session 5: Zinc-blende Gallium Nitride - Chair: Prof. Peter Parbrook
Computational Foundry, Lecture Theatre 002

11.15-11.30 **Correlative CL-SEM and CL-STEM microscopy to understand dopant segregation in Mg doped Cubic Gallium Nitride**
S. Fairclough[1], M. Frentrup[1], Z. Zhou[2], S. Roberston[2], M. Kappers[1], K. Bukvišová[3], C. C. Mitterbauer[3], J. Maniš[3], S. Vespucci[3], C. Ozsoy-Keskinbora[3], D. Wallis[1, 4], R. Oliver[1], G. Kusch[1]
[1]University Of Cambridge, Cambridge, United Kingdom, [2]Loughborough University, United Kingdom, [3]Thermo Fisher Scientific, Netherlands, [4]Cardiff University, United Kingdom

11.30-11.45 **Thermodynamic and Electronic Properties of Wurtzite and Zincblende Based GaN Alloyed Compounds**
M. M. Islam[1], Z. Wang[1], D. Bowler[1]
[1]Cardiff University, United Kingdom

11.45-12.00 **Multi-microscopy study of an on-axis zincblende InGaN/GaN single quantum well sample**
X. Xu[1], M. Frentrup[1], A. Power[3], Z. S. Pehlivan[1], G. Kusch[1], M. J. Kappers[1], S. Schulz[3], D. J. Wallis[1,2], R. A. Oliver[1]
[1]University Of Cambridge, Cambridge, United Kingdom, [2]Centre for High Frequency Engineering, University of Cardiff, United Kingdom, [3]School of Physics, Tyndall National Institute, University College Cork, Ireland

12.00-12.15 **Polarisation-Resolved Optical Properties of an MOVPE Grown Cubic InGaN/GaN Quantum Well on 3C-SiC/Si Substrate**
W. Fieldhouse-Allen[1], M. Kappers[2], M. Frentrup[2], D. Wallis[3], R. Oliver[2], D. Binks[1]
[1]Department of Physics and Astronomy, University of Manchester, United Kingdom, [2]Department of Materials Science & Metallurgy, University of Cambridge, United Kingdom, [3]Centre for High Frequency Engineering, Cardiff University, United Kingdom

12:15- 13:15 Flash Presentations for posters
Computational Foundry, Lecture Theatre 002
2 minutes per poster (maximum of a title slide plus two other slides)

13:15- 14:30 Lunch & Poster Session
Computational Foundry, Ground Floor Foyer and Networking Space (Room 001)

14:30- 15:45 Session 6: Ultrawide Bandgap Devices - Prof. David Wallis
Computational Foundry, Lecture Theatre 002

14.30 -14.45 **Achieving n- and p-type conductivity in high Al-content AlGaN by MOVPE for developing AlGaN-based vertical transistors**

A. Chatterjee[1], Z. Pehlivan[1], Y. Yin[2], M. Frentrup[1], S. A. Dar[1], M. J. Kappers[1], M. D. Smith[2], D. J. Wallis[3], M. Kuball[2], R. A. Oliver[1]
[1]University Of Cambridge, Cambridge, United Kingdom, [2]University of Bristol, United Kingdom, [3]Cardiff University, United Kingdom

14.45 -15.00 **Ohmic contact development for Al-rich channel high electron mobility transistors**
Dr. Jayjit Mukherjee[1], Pietro Pampili[1], Badal Mondal[1], Peter James Parbrook[2,3], Stefan Schulz[2,4], David Moran[1]
[1]James Watt School of Engineering, University of Glasgow, Glasgow G12 8LT, Glasgow, United Kingdom, [2]Tyndall National Institute, University College Cork, Cork T12 R5CP, , Ireland, [3]School of Engineering, University College Cork, Western Road, Cork, , Ireland, [4]School of Physics, University College Cork, Cork T12 YN60, , Ireland

15.00 -15.15 **Design and Performance Outlook of Ultrawide Bandgap AlGaN Power Electronics**
Y. Yin[1], M. Smith[1], J. Pomeroy[1], M. Kuball[1],
[1]Center for Device Thermography and Reliability, University of Bristol, Tyndall Avenue, Bristol , United Kingdom

15.15 -15.30 ***Surface study and influence of native oxides on the sheet resistance of Al-rich channel high electron mobility transistors***
Dr. Jayjit Mukherjee[1], Badal Mondal[1], Pietro Pampili[1], Christopher Kelly[3], Peter James Parbrook[2,4], Stefan Schulz[2,5], David Moran[1]
[1]James Watt School of Engineering, University of Glasgow, Glasgow G12 8LT, Glasgow, United Kingdom, [2]Tyndall National Institute, University College Cork, Cork T12 R5CP, , Ireland, [3]School of Chemistry, University of Glasgow, Glasgow, G12 8QQ, United Kingdom,*[4]School of Engineering, University College Cork, Western Road, Cork, Ireland, [5]School of Physics, University College Cork, Cork T12 YN60, Ireland*

15.30 -15.45 **Normally-off N-polar GaN/AlN transistors with p-NiO gate stacks**
C. Zhang[1], Y. Yin[1], P. Huang[1], I. Furuhashi[2], M. Pristovsek[2], M. Kuball[1], M. D. Smith[1]
[1]Center for Device Thermography and Reliability, University of Bristol, Bristol, Bristol, United Kingdom; [2]Center for Innovative Research of Future Electronics, Nagoya University, Nagoya, Japan

15:45-16:00 Closing Remarks & Student Prizes
Computational Foundry, Lecture Theatre 002

16:00 Depart

Posters (8th Jan 2026 13.15-14:30)

Computational Foundry, Ground Floor Foyer and Networking Space (Room 001)

1. **Heteroepitaxial Growth and In Situ Si Doping of β-Ga_2O_3 Thin Films on Miscut Sapphire 6.0° Using a MOCVD Close-Coupled Showerhead Reactor**
   Ciaran Llewelyn[1], Dan Lamb[1]
   [1]*The Oxide and Chalcogenide Centre, Centre for Integrative Semiconductor Materials (CISM) and Faculty of Science and Engineering, Swansea University, Swansea, SA1 8EN, UK, Swansea, United Kingdom*

2. **Automated Quantification and Classification of Threading Dislocations in GaN using AFM and Deep Learning**
   Mr Cobi Allen[1], Aisha Mariam[1], Jiawei Zhang[1], Gunnar Kusch[1]
   [1]*University Of Cambridge, , United Kingdom*

3. **Investigating the effect of the NH3 pre-dose time on compressive strain and threading dislocation density in GaN-on-Si structures**
   Miss Aisha Mariam[1], Martin Frentrup[1], Petr Vacek[1], Menno J Kappers[1], Rachel A Oliver[1]
   [1]*University Of Cambridge, United Kingdom*

4. Drift–Diffusion Computation for High-Voltage Optimization of β-Ga_2O_3 FinFETs
   Nicholas edwards[1], Antonio Muniz[1], Jon Evans[1], Jacob Mitchel[1], Owen Guy[1], Huma Ashraf[1], Mike Jennings[1]
   [1]*Swansea University, Swansea, United Kingdom*

5. **Theoretical characterization of the Wurzite and Zincblende GaN stacking faults**
   Dr Mohammad Mazharul Islam[1], **Zijie Wang**[1], David Bowler[1]
   [1]*Cardiff University, Cardiff, United Kingdom*

6. **Low Earth Orbit Radiation Response and Photoconduction of β-$(Al_xGa_{1-x})_2O_3$ Alloys**
   Farnaz Hadizadeh[1], Sean douglas[3], Arpit Nandi[3], Sai Charan Vanjari[2], Viesturs Spūlis[1], Robbie Wilson[1], Ross Gray[1], Stephen Reynolds[3], Daniel Oi[1], Susan Spesyvtseva[1], Paul McKenna[1], Robert Martin[1], Martin Kuball[2], David Keeble[3], Matthew Smith[2], Fabien Massabuau[1]
   [1]*Department of Physics, SUPA, University of Strathclyde, Glasgow, UK, , United Kingdom,* [2]*Department of Physics, University of Bristol, Bristol, UK, , United Kingdom,* [3]*School of Science and Engineering, University of Dundee, Dundee, UK, , United Kingdom*

7. **Optimisation of porous GaN distributed Bragg reflectors using low concentration** electrochemical etching
   Ben Thornley[1], Zetai Xu[1], Thom R. Harris-Lee[1], Menno Kappers[1], Piotr Sokolinski[1], Rachel A. Oliver[1]
   [1]*Department of Materials Science and Metallurgy, University of Cambridge, , United Kingdom*

8. **Stability of AlGaN/GaN HEMTs and Schottky diodes on Si irradiated by 60Co gamma rays**
   Sami Kibal[1], Menno Kappers[1], Ruth Edge[2], Emil Jonasson[3], Rachel Oliver[1]
   [1]*University Of Cambridge, Cambridge, United Kingdom,* [2]*Dalton Cumbrian Facility, University of Manchester, , United Kingdom,* [3]*Remote Applications for Challenging Environments (RACE), UK Atomic Energy Authority (UKAEA), , United Kingdom*

9. **Electron-irradiation-induced EE1 trap in GaN: unusual electronic properties of a defect linked to the nitrogen vacancy**
Christopher Dawe[1], Piotr Kruszewski[2], Vladimir Markevich[1], José Coutinho[3], Lijie Sun[1], Paweł Prystawko[2], Jerzy Plesiewicz[2], Matthew Halsall[1], Anthony Peaker[1]
[1]Photon Science Institute, The University Of Manchester, , United Kingdom, [2]Institute of High Pressure Physics and Polish Academy of Sciences, , Poland, [3]i3N and Department of Physics, University of Aveiro, , Portugal

10. **Mesa-Terminated Vertical GaN Diodes: Substrate-Dependent Performance Limits**
Mritunjay Kumar[1], Chengzhi Zhang[1], Martin Kuball[1], Matthew Smith[1]
[1]CDTR, HH Wills Physics Laboratory, University of Bristol, Bristol, United Kingdom

11. **Time-of-Flight Elastic Recoil Detection Analysis of Proton Induced Compositional Changes in Wide Band Gap Perovskites for Space Applications**
Dr Matthew Sharpe[1], Hongjae Shim[2], Callum McAleese[1], Jae Yun[3]
[1]Surrey Ion Beam Centre, University Of Surrey, GUILDFORD, United Kingdom, [2]Australian Centre for Advanced Photovoltaics (ACAP), School of Photovoltaic and Renewable Energy Engineering, University of New South Wales, , Australia, [3]Advanced Technology Institute, University of Surrey, , United Kingdom

12. **Effect of indium composition on the light emission from MOVPE-grown cubic InxGa1-xN epilayers**
Haoyang Sun[1], Daniel Dyer[1], Menno Kappers[2], Martin Frentrup[2], David Wallis[2,3], Rachel Oliver[2], David Binks[1]
[1]Photon Science Institute & Department of Physics and Astronomy, University of Manchester, Manchester, United Kingdom, [2]Department of Materials Science and Metallurgy, University of Cambridge, Cambridge, , United Kingdom, [3]Centre for High Frequency Engineering, Cardiff University, Cardiff, , United Kingdom

13. **Homogeneity Evaluation and Single Pallet Characterization of UV-B Micro-LED Structures using Cathodoluminescence**
Rong Teng[1], Oliver Short[1], Zeki S. Pehlivan[1], Rachel A. Oliver[1], Gunnar Kusch[1]
[1]Department of Material Science and Metallurgy, University of Cambridge, , United Kingdom

14. **Morphology of Gallium Oxide Thin Films on c-axis Sapphire Grown by Metal Oxide Chemical Vapour Deposition (MOCVD)**
Ms Shreyasi Maitra[1,2], Dan Lamb[2], Indraneel Sanyal[3], Ciaran Llewelyn[2], Paul Meredith[2,4], David Ritchie[2], Saptarsi Ghosh[1,2]
[1]Department of Electronic and Electrical Engineering, Swansea University, Swansea, United Kingdom, [2]Centre for Integrative Semiconductor Materials, Swansea University, Swansea, , United Kingdom, [3]AIXTRON PLC, Buckingway Business Park, Swavesey, Cambridge, , United Kingdom, [4]Department of Physics, Swansea University, Swansea, , United Kingdom

15. **Dependence of the Ohmic Process on the Temperature-Dependent Characteristics of AlGaN/GaN Heterostructure Diodes**
NITISH RANA[1], Saptarsi Ghosh[1,2], Mike Jennings[1,2], John Evans[2], Ahmed Benkhaial[2], Nick Edwards[2]
[1]Department of Electronic and Electrical Engineering, Swansea University, , United Kingdom, [2]Centre for Integrative Semiconductor Materials, Swansea University, , United Kingdom

16. **An initial study of electrochemical porosification of Mg-doped p-type GaN**
Jiawei Zhang[1], Thom Harris-Lee[1], Menno Kappers[1], Rachel Oliver[1]
[1]*University Of Cambridge, Cambridge, United Kingdom*

17. **Origin and properties of p-layer surface hillocks in AlGaN-based deep-UV LEDs**
Viesturs Spūlis[1,2], Christoph Margenfeld[3], Paul R. Edwards[1], Gunnar Kusch[2], Andreas Waag[3], Robert W. Martin[1]
[1]*University of Strathclyde, , United Kingdom,* [2]*University of Cambridge, , United Kingdom,* [3]*Technische Universität Braunschweig, , Germany*

18. **Impact of anisotropic strain on the electronic and optical properties of zincblende (In,Ga)N quantum wells**
Aisling Power[1], D. Dyer[2], W. Fieldhouse-Allen[2], X. Xu[3], M. Frentrup[3], Z. S. Pehlivan[3], G. Kusch[3], M. J. Kappers[3], D. J. Wallis[3,4], R. A. Oliver[3], D. J. Binks[2], S. Schulz[1]
[1]*School of Physics & Tyndall National Institute, University College Cork, , Ireland,* [2]*Department of Physics and Astronomy & Photon Science Institute, University of Manchester, , United Kingdom,* [3]*Department of Materials Science and Metallurgy, University of Cambridge, United Kingdom,* [4]*Centre for High Frequency Engineering, University of Cardiff, , United Kingdom*

19. **Effects of carbon-doped buffer thickness and back-barrier structures on the electrical behaviour of GaN HEMTs**
Zubear Nowshad Pasha[1] , Christopher Dawe[2], Matthew Halsall[2], Iwan Davies[3], Naresh Gunasekar[1]
1) School of Physics and Astronomy, Cardiff University, The Parade, Cardiff, CF24 3AA, UK
2)Department of Electrical and Electronic Engineering, The University of Manchester, Manchester, M139PL, UK
2)IQE plc, Pascal Close, St. Mellons, Cardiff CF3 0LW, United Kingdom